IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of : Confirmation No. 6336
Serial No. 10/558,932 : Group Art Unit: 1796
Yoshiaki TAKAGI et al. : Examiner: Kriellion A. Sanders
Filed: January 19, 2006

DECLARATION UNDER 37 CFR 1.132

Honorable Commissioner of Patent and Trademarks

Sir:

I, Tomoya TAKATA declare that:

I was born in Toyama, Japan, on May 7, 1975;

I am an inventor of the above-identified US patent Application;

I am a citizen of Japan and a resident of c/o TANAKA SEIMITSU KOGYO CO., LTD., 7-10, Shinjohonmachi 2-chome, Toyama-shi, Toyama 930-0996, Japan;

I graduated from Department of Mechanical Engineering, College of Engineering, Kanazawa Institute of Technology, Ishiwaka, Japan in 1998;

I took the bachelor degree on the study of the tribology at Kanazawa Institute of Technology, Ishiwaka, Japan in 1998. My bachelor work dealt with the research of effects of road surface on a friction coefficient of vehicle tire;

I have been an employee of TANAKA SEIMITSU KOGYO CO., LTD., Japan, since 1998 up to this time, and have been engaged

in the research & development on automotive parts;

At present, I am a chief of Engineering Block.

The experiment set out below was conducted under my supervision and direction.

Experiment 1

Synchronization unit performance test - Effect of coke material and ash content on synchronization performance -

(1) Test Method

Synchronizer rings having a friction material layer comprising the friction material as shown in Table 1 were manufactured according to a method described on page 12, line 24 - page 13, line 24 of the specification as originally filed.

Sample 1 comprises a calcined petroleum coke with an ash content of 0.15 mass%. Sample 2 comprises a pitch coke with an ash content of 1.6 mass%. Sample 3 comprises a raw petroleum coke with an ash content of 10 mass%. Sample 4 comprises an artificial graphite with an ash content of 0.5 mass%. In addition, a conventional synchronizer ring made of brass (Sample 5) was also examined.

A synchronization unit test machine was used to measure an average coefficient of dynamic friction of a synchronizer ring against a tapered counterpart member. In this synchronization unit test machine, a synchronizer ring was pressed by an oil hydraulic cylinder.

An inertial weight was set at 0.015 kgf $\cdot$ m^2. Each synchronizer ring was placed in a transmission oil (oil kind:

Honda MTF-II) at 80°C and was repeatedly pressed at a pressing force of 500 N against a tapered counterpart member (name: gear cone; material: SCM420; heat treatment: carburizing, quenching and tempering; tapered face: processed by grinding) rotating at a rotational speed difference of 2000 rpm for lapping. 300 cycles of lapping were performed to measure an average coefficient of dynamic friction of each synchronizer ring.

Table 1 Material content of Samples 1-5 & Result of synchronization unit performance test

		Material content (mass%)						Average coefficient of dynamic friction (after 300 cycles of lapping)*2
		Calcined petroleum coke	Pitch coke	Raw petroleum coke	Artificial graphite	Novolac type phenolic resin (thermo-setting resin)	Wollastonite fiber*1 (inorganic fiber)	
		Ash content of 0.15 mass%	Ash content of 1.6 mass%	Ash content of 10 mass%	Ash content of 0.5 mass%			
		Particle diameter of 0.1 to 0.5 mm	←	←	←			
Inventive product	Sample 1	65	-	-	-	15	20	0.131
Comparative product	Sample 2	-	65	-	-	15	20	0.125 (-0.006)
	Sample 3	-	-	65	-	15	20	0.117 (-0.014)
	Sample 4	-	-	-	65	15	20	0.119 (-0.012)
	Sample 5	Conventional brass synchronizer ring						0.113 (-0.018)

Note:
*1 Wollastonite fiber has an average fiber diameter of 8 μm.
*2 Numerical values in parenthesis designate difference from Sample 1

(2) Test Result

Table 1 shows the result of synchronization unit performance test which investigates an effect of coke material and ash content on synchronization performance.

As shown in Table 1, the average coefficient of dynamic friction of Sample 1 (inventive product) is 0.006-0.018 higher than those of Samples 2-5 (comparative products). Generally, a synchronization performance of a synchronizer ring significantly improves by increasing an average coefficient of dynamic friction of the friction material by at least 0.005. Thus, Sample 1 has a significantly excellent synchronization performance in comparison with Samples 2-5.

From this result, it is clear that the friction material comprising a calcined petroleum coke with an ash content of 0.15 mass% exhibits a significantly excellent synchronization performance in comparison with other friction materials.

Experiment 2

Synchronization unit performance test - Effect of calcined petroleum coke particle diameter on synchronization performance and abrasion resistance -

(1) Test Method

Synchronizer rings having a friction material layer comprising the friction material as shown in Table 2 were manufactured according to a method described on page 12, line 24 - page 13, line 24 of the specification as originally filed.

The calcined petroleum cokes in Samples 6, 7 and 8 have

a particle diameter of 0.1 to 0.5 mm, less than 0.1 mm and more than 0.5 to 1 mm, respectively, obtained through classification using a standard sieve.

A synchronization unit test was carried out in the same condition as Experiment 1, except that 500 cycles of lapping were performed to measure an average coefficient of dynamic friction of each synchronizer ring.

Table 2 Material content of Samples 6-8 & Result of synchronization unit performance test

		Material content (mass%)						Average coefficient of dynamic friction (after 500 cycles of lapping)	Abrasion state of friction material
		Calcined petroleum coke			Novolac type phenolic resin (thermo-setting resin)	Glass fiber*1 (inorganic fiber)	Artificial graphite*2 (graphite)		
		Ash content of 0.15 mass%							
		Particle diameter							
		0.1 to 0.5 mm	Less than 0.1 mm	More than 0.5 to 1 mm					
Inventive product	Sample 6	50	-	-	15	30	5	0.135	None
Comparative product	Sample 7	-	50	-	15	30	5	0.131	Almost none
	Sample 8	-	-	50	15	30	5	0.136	Partial chip occurred

Note:
*1 Glass fiber has an average fiber length of 74 μm and an average fiber diameter of 8 μm.
*2 Artificial graphite has an average particle diameter of 250 μm.

(2) Test Result

Table 2 shows the result of synchronization unit performance test which investigates an effect of calcined petroleum coke particle diameter on synchronization performance and abrasion resistance.

As shown in Table 2, the average coefficient of dynamic friction of Sample 6 (inventive product) is higher than that of Sample 7 (comparative product). Further, the abrasion state of Sample 6 (inventive product) is superior to that of Sample 8 (inventive product).

From these results, it is clear that a friction material comprising a calcined petroleum coke having a particle diameter within the range of 0.1 to 0.5 mm exhibits excellent synchronization performance and abrasion resistance in comparison with that having a particle diameter outside the range of 0.1 to 0.5 mm.

It is declared by the undersigned that all statements made herein of undersigned's own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and that such willful false statements may jeopardize the validity of the above-identified application or any patent issuing thereon.

This 17th day of July, 2008

Tomoya Takata

Tomoya TAKATA